Commonwealth of Pennsylvania

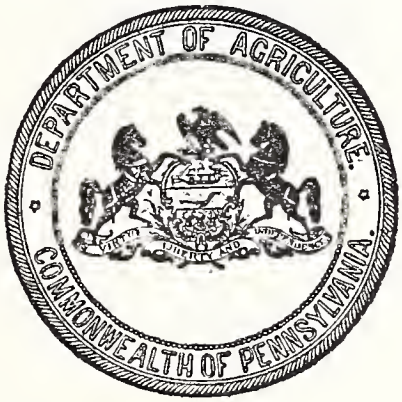
DEPARTMENT OF AGRICULTURE
DAIRY AND FOOD DIVISION

BULLETIN No. 268

Milk, Butter, and Feeding and Management of Dairy Cows

BY

Prof. C. B. Cochran, Prof. H. E. Van Norman
Mrs. Jean Kane Foulke



N. B. CRITCHFIELD, *Secretary of Agriculture.*
JAMES FOUST, *Dairy and Food Commissioner.*

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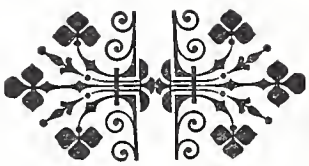

PREFACE.

The rapidly increasing interest in Dairy-husbandry, not only in Pennsylvania but throughout the United States, has led to the important inquiry as to which of several dairy breeds of cattle are the most profitable.

The most popular of the dairy breeds in Pennsylvania seem to be the Holstein, brought from Holland by the early Dutch immigrants from that country to New York and the Jersey and Guernsey imported from the English Channel Islands in the early part of the last century.

The relative value of these respective breeds has become a subject of popular discussion not only among the dairymen of our State but among consumers of dairy products.

The very large quantity of milk yielded by the Holstein attracts special attention to this breed, not only on account of the constantly increasing importance of our milk market but as a butter producer, while the Jersey and Guernsey are held in high esteem on account of the comparatively large quantity and superior quality of butter they produce.

There is, however, one subject in which all dairymen, whether producing butter or milk, are equally interested, namely, the Feeding and Proper Management of Dairy Cows. Other subjects of special importance to butter makers are, The Handling of Milk and Cream, Care of Utensils Used and the proper treatment of butter from the time it is taken from the churn until it reaches the market.

In order that the scientific side of all these important subjects may be brought to the attention of dairymen as well as their patrons, Hon. James Foust, Dairy and Food Commissioner, has had a special investigation made, showing a comparison of the properties of the milk of the three breeds of dairy cattle that hold most prominent places in Pennsylvania, the report of which is found in the following pages, to which is added a very superior paper read by Prof. H. E. Van Norman, formerly of State College, Pa., before the Annual Normal Farmers' Institute at Towanda, Pa., in 1912, on the

"Feeding and Management of Dairy Cows"; and a like interesting paper on "Essentials of Butter Making," read by Mrs. Jean Kane Foulke, of West Chester, Pa., before the Annual Normal Institute held in Lancaster, Pa., in 1911.

The publication of the Report and Papers referred to as a Bulletin of the Department of Agriculture, is authorized on account of their special value to the Dairy industry of the State.

N. B. CRITCHFIELD,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

Harrisburg, Pa., August 4, 1915.

Honorable N. B. Critchfield,
Secretary of Agriculture,

Harrisburg, Pa.

Dear Sir:—I have the honor to transmit herewith a comparison of the composition of the milk of different breeds of cows by Professor C. B. Cochran, West Chester; also feeding and management of dairy cows by Professor H. E. Van Norman, State College, Pa., together with essentials of butter making by Mrs. Jean Kane Foulke, of West Chester, with the recommendation that it be published as *Bulletin No. 268* of the Department.

Very respectfully,

JAMES FOUST,
Dairy and Food Commissioner.

A COMPARISON OF THE COMPOSITION OF MILK OF DIFFERENT BREEDS OF COWS.

By Professor C. B. Cochran, West Chester.

The fact that certain breeds of cows, such as the Holstein, Dutch Belt, and Syrshire, yield a milk low in fat and in total solids, while the milk of the Jersey and Guernsey breeds is high in both of these constituents, is quite generally recognized.

There are, however, other characteristic differences in the milk of these breeds which are not so well known and to which attention has only recently been directed. In an article by H. C. Lythgoe, published in the Journal of Engineering and Industrial Chemistry, for November, 1914, is given a long list of the analyses of the milk of different breeds of cows. From this article, from the reports of the New Jersey Agricultural Experiment Stations, and from other sources, as well as from my own work, are derived the figures given in the following table, to show the average composition of the milk of each of these breeds.

TABLE I.—Showing Average Composition of Milk of Different Breeds of Cows.

	Holstein-Friesian.	Jersey.	Guernsey.
	%	%	%
Total solids,	12.06	14.83	14.56
Fat,	3.46	5.36	5.12
Milk sugar,	4.75	4.96	4.92
Proteins,	3.20	3.77	3.75
Ash,	0.70	0.74	0.75
Solids not fat,	8.60	9.47	9.44
Solids not fat to 100 pts. water,	9.77	11.11	11.05
Ratio of fat to solids not fat,	40.2 to	10056.6 to 100	54.2 to 100
Fat in total solids,	28.6	36.2	35.2
Milk sugar in solids not fat,	55.2	52.3	52.1
Proteins in solids not fat,	37.2	40.0	39.7
Ash in solids not fat,	8.15	7.8	8.0

An inspection of this table shows that there are less solids not fat, and fat in proportion to the water in the milk of the Holstein-Friesians than in Jersey or Guernsey milk. The ratio of fat to solids not fat is about four-tenths in Holstein milk, while in Jersey and Guernsey milk the ratio is about fifty-five-hundredths. The fat forms a much smaller percentage of the total solids in Holstein milk than in Jersey or Guernsey milk.

In the solids not fat of Holstein-Friesian milk, there is a higher percentage of milk sugar and ash and a lower percentage of protein than in the milk of either the Jersey or Guernsey breeds.

The following table is abbreviated from one of the tables in H. C. Lythgoe's article, to which reference has been made. The figures in the four lower rows have been calculated by myself and added to the original table. The figures in the upper row, opposite number of samples, 36, 28, 41, and 56, indicate the number of individual cows from which the samples were taken, while the number 47 indicates that the mixed milk of 47 different herds were examined.

The percentage of fat in total solids is here seen to be distinctly greater in the Jersey and Guernsey milk than in the Dutch Belt and Holstein, while the percentage of ash in solids not fat appears to be distinctly greater in the Holstein milk than in the other breeds. The percentage of milk sugar in the solids not fat is somewhat higher in the milk of the Dutch Belt and Holstein cows than in the milk of the Jersey and Guernsey breeds.

TABLE II.—Summary of Analyses of Milk of Known Purity.

		Jersey.	Guernsey.	Dutch Belt.	Holstein.	Herd milk.
No. of samples,		% 36	% 28	% 41	% 56	% 47
Total solids,	Max.,	17.17	17.00	14.09	13.90	14.57
	Min.,	12.43	12.15	10.93	10.20	11.56
	Ave.,	14.75	14.60	12.15	11.69	12.79
Fat,	Max.,	7.70	6.40	4.75	4.60	5.40
	Min.,	4.20	3.80	3.00	2.45	3.35
	Ave.,	5.65	5.23	3.56	3.41	4.03
Proteins,	Max.,	4.42	5.01	3.61	4.03	4.07
	Min.,	2.79	2.26	2.34	2.00	2.65
	Ave.,	3.46	3.73	2.96	3.27	3.31
Ash,	Max.,	0.84	0.84	0.77	0.84	0.79
	Min.,	0.64	0.69	0.63	0.64	0.65
	Ave.,	0.72	0.75	0.70	0.72	0.74
Milk sugar,	Max.,	5.80	5.22	5.25	5.20	5.25
	Min.,	4.10	4.46	4.20	4.08	4.35
	Ave.,	4.94	4.84	4.93	4.70	4.83
Solids not fat,	Max.,	9.80	10.65	9.43	9.61	9.48
	Min.,	8.13	8.00	7.63	7.55	7.63
	Ave.,	9.10	9.37	8.59	8.28	8.76
Fat in total solids,	Max.,	47.4	38.6	31.8	33.5	37.1
	Min.,	33.1	31.0	26.3	25.0	28.2
	Ave.,	38.3	35.9	30.9	29.2	31.6
Ash of sour milk serum,	Max.,	0.828	0.824	.....	0.860	0.852
	Min.,	0.740	0.776	.....	0.730	0.764
	Ave.,	0.786	0.804	.....	0.793	0.792
Solids not fat to 100 parts water,	Ave.,	10.67	10.85	9.66	9.38	10.04
Ash in solids not fat,		7.91	8.00	8.15	8.69	8.44
Milk sugar in solids not fat,		54.2	51.6	57.4	56.7	55.1
Protein in solids not fat,		38.0	39.8	34.4	38.2	37.7

In addition to this table, Dr. Lythgoe has kindly furnished me further data which is explained by the accompanying letter and the table following it.

"MASSACHUSETTS
STATE DEPARTMENT OF HEALTH.

"Mr. C. B. Cochran,
West Chester, Pa.

Boston, July 20, 1915.

"Dear Sir:—In response to yours of June 28th, I beg to inform you that the enclosed are the analyses of the samples of Jersey, Guernsey, and Holstein milk, giving the highest and lowest solids and fat of those recorded in my article published in November last.

"The numbers 36, 28, and 56 represent the number of different cows from which the samples were taken. The samples of herd milk were taken from 47 different herds. ....."

"Yours truly,

(Signed) HERMAN C. LYTHGOE,
"Director, Division of Food and Drugs."

TABLE III.

	Solids.	Fat.	Proteins.	Ash.	Solids not fat.	Lactose.
Jersey, ...	17.17	7.70	3.65	0.72	9.47	5.05
Jersey, ...	12.43	4.30	2.98	0.68	8.13	4.80
Jersey, ...	12.80	4.20	2.97	0.67	8.60	5.10
Guernsey, ...	17.00	6.35	4.93	0.80	10.65	4.92
Guernsey, ...	16.33	6.40	4.63	0.82	9.63	4.78
Guernsey, ...	12.15	4.15	2.26	0.69	8.00	5.05
Guernsey, ...	12.23	3.80	2.98	0.75	8.47	4.70
Holstein, ...	13.96	4.35	4.03	0.76	9.61	4.82
Holstein, ...	13.84	4.60	3.71	0.70	9.24	4.73
Holstein, ...	10.20	2.65	2.40	0.65	7.55	4.50

TABLE III—Continued.

	Copper serum refraction.	Sour serum refraction.	Sour serum ash.	Ratio of fat to solids not fat.	Solids not fat to 100 pts. water.	Ash in solids not fat.
						%
Jersey, ...	39.5	.....	.....	81.3 to 100	11.43	7.60
Jersey, ...	37.4	40.7	0.789	52.9 to 100	9.28	8.12
Jersey, ...	38.3	40.0	0.740	48.8 to 100	9.86	7.80
Guernsey, ...	38.9	.....	.....	59.6 to 100	12.80	7.51
Guernsey, ...	37.5	.....	.....	66.4 to 100	11.86	8.51
Guernsey, ...	37.4	.....	.....	52 to 100	9.11	8.62
Guernsey, ...	37.4	.....	.....	44.8 to 100	9.65	8.85
Holstein, ...	37.9	.....	.....	45 to 100	11.16	7.91
Holstein, ...	38.0	.....	.....	49.8 to 100	10.72	7.57
Holstein, ...	36.5	.....	.....	35.1 to 100	8.41	8.61

In Table III is given the result of the analyses of the samples of milk taken from the 36 Jersey cows, 28 Guernseys, and 56 Holsteins which gave the highest and lowest figures for total solids and fat. It will be noticed in this table that an increase in total solids is not always attended by an increase in butter fat, and solids not fat, but may be due to an increase in either one or the other of these constituents. For example, the sample of Jersey milk containing 12.43% of total solids has 4.3% of fat while the sample containing 12.80% of total solids has only 4.20% of fat.

The columns headed ratio of fat to solids not fat; solids not fat to 100 quarts of water; and ash in solids not fat have been calculated and inserted by myself. The column giving the ratio of fat to solids not fat shows that in Jersey and Guernsey milk, the fat is almost always more than one-half as great as the solids not fat, and may, in extreme cases, be more than eight-tenths as great as the solids not fat; while in Holstein milk the fat is less than one-half as great as the solids not fat, and may fall to about one-third.

The column headed ash in solids not fat shows that, even in these extreme cases, the percentage of ash in the solids not fat of Holstein milk is as high as that found in Jersey or Guernsey milk.

The morning and evening milk of each cow in two herds was recently analyzed by me. In one of these herds were five grade Holsteins; in the other fourteen. The following tables give the results of the average of the morning and evening tests of each of these cows in each dairy. The samples were all taken by Mr. G. M. Pelton, one of the agents of the State Dairy and Food Department. The cows were milked in his presence, and in each case the milk was well mixed before taking sample.

TABLE IV.—Dairy No. 1.

No. of Cow.	Sp. Gr.	Fat.	Total solids.	Solids not fat.	Solids not fat to 100 pts. water.
		%			
1,	1.0314	3.55	12.37	8.82	10.07
2,	1.031	3.05	11.56	8.51	9.68
3,	1.0296	2.65	10.70	8.05	8.95
4,	1.032	3.30	12.20	8.90	10.12
5,	1.0315	3.17	11.81	8.63	9.78
Ave. of five cows,	1.0311	3.24	11.73	8.58	9.72

TABLE V.—Dairy No. 2.

No. of Cow.	Sp. Gr.	Fat.	Total solids.	Solids not fat.	Solids not fat to 100 pts. water.
		%			
1,	1.0312	2.95	11.47	8.52	9.62
2,	1,0305	2.22	10.38	8.16	9.14
3,	1.0303	2.70	10.91	8.21	9.21
4,	1.0317	3.60	12.49	8.86	10.1
5,	1.0315	3.90	12.71	8.81	10.1
6,	1.0295	2.55	10.43	8.09	9.05
7,	1.032	2.95	11.68	8.63	9.76
8,	1.030	3.50	11.85	8.36	9.49
9,	1.0306	3.45	11.95	8.50	9.65
10,	1.0312	3.45	12.10	8.66	9.91
11,	1.0303	2.75	11.03	8.28	9.30
12,	1.0307	3.05	11.45	8.40	9.49
13,	1.0308	3.25	11.75	8.50	9.63
14,	1.030	3.50	11.86	8.36	9.90
Ave. of the 14 cows,	1.0307	3.13	11.58	8.45	9.60

The average of the ten analyses of the morning and evening milk of the five cows of Dairy No. 1 is distinctly below the legal standard of 12% for total solids, and slightly below the standard of 3.25% for fat. In Dairy No. 2, the average of the morning and evening tests of the fourteen cows gives results distinctly below the legal standard in both total solids and fat. The Holstein cows are noted for their abundant flow of milk, and they have been bred for a very large number of generations for the special purpose of producing quantity of milk with either little or no regard for quality. On the other hand, in the breeding of Jersey and Guernsey cows, richness in butter fat has been the primary object. In each of these processes, the tendency is to the production of more or less abnormal milk. It should be remembered that the primary purpose of the milk of the cow is to serve as food for the new born calf. Under the primitive conditions of nature, the milk of the healthy normal cow would be approximately, at least, a perfect food for the young calf, and such milk would constitute a normal milk, as determined by nature. But when man interferes, and attempts by a process of selection to increase the percentage of butter fat in the milk, or to increase as far as possible the quantity of milk, which results in an increased percentage of water in the fluid, he is, by breeding and selection, producing animals incapable of furnishing to their own young a suitable food, or, in other words, a normal milk.

Many years ago, I stated at a meeting of the Guernsey Breeders Club that, in my opinion, the milk of Guernsey cows containing all its fat was too rich a food for very young infants. One of the members present expressed opposition to my view. A newspaper report of the proceedings of the next meeting of this same club stated that a conclusion had been formed by the members that Guernsey milk was too rich for new born Guernsey calves. Whether my opinion or that of the club is correct or not, in this case, the general fact that breeding tends to the production of a milk that is abnormal in the sense that it is not suited to its natural function is undoubtedly true.

Another interesting phase of this subject is to be found in the difference in quantity and quality of cows' milk according to the length of time since the birth of the calf. It is a well known fact that in the early stages of lactation a cow gives a large quantity of milk of comparatively poor quality; and, as the period of lactation approaches its end, the quantity decreases, while the richness of the milk increases. So that the percentage of fat in the product near the end of lactation may be more than double what it was at the beginning. This fact, which is universal in all herds, evidently means that, as the age of the young calf advances, it is able to utilize a more concentrated food.

While it is evidently possible to produce a milk abnormally rich, in the sense that it is not suited to its natural function, it is also possible to produce a milk abnormally poor in exactly the same sense. The production and sale of such abnormally poor milk for household use is undesirable, both in a physiological and in a commercial sense.

The food value of a quart of milk depends not upon the percentage of water, practically a free product, which it contains, but upon the percentage of actual food solids. A quart of milk, containing 11% of solids, other conditions being the same, is worth only eleven-fiftenths as much as a quart of milk containing 15% of solids. In other words, breeding for quantity of milk, when carried to its extremes, becomes only another way of watering the product. It is, therefore, in my opinion, distinctly within the province of the State to fix legal limits for fat and total solids, and this is especially true, so long as milk is sold, as it now is, at a uniform price per quart, without regard to its actual food value.

A determination of the ratio of solids not fat to water furnishes a valuable addition to the methods now used for the detection of added water in milk.

It will be noticed that in case of the two dairies furnishing the remarkably low figures given in the preceding tables, the ratio of solids not fat to water is 9.72 to 100 and 9.60 to 100 and I think it is safe to say that the milk from these herds represents about the lowest limit of pure milk from healthy cows to be found upon our markets. Consequently, when the ratio of solids not fat to water falls below 9.60 there would be a cause for suspecting the presence of added water.

The ratio of solids not fat to water in a given sample of milk will remain the same in the skim milk and in the cream as in the original milk, although the actual figures for solids not fat in the milk, skim milk and cream will differ considerably. This fact is well shown by the figures given in the following table:

TABLE VI.—Showing Relation of Solids Not Fat to Water in a Given Milk, and in the Cream and Skim Milk Derived Therefrom.

Number.	Sample.	Total solids.	Fat.	Solids not fat.	Solids not fat to 100 pts. water.
1	Milk,	12.11	3.3	8.81	10.02
2	Cream from No. 1,	37.14	30.8	6.34	10.02
3	Skim milk from No. 1,	0.11	0.0	9.11	10.01
4	No. 2 100 pts—No. 1 20 pts.,	33.00	26.2	6.80	10.14
5	No. 4 100 pts.—No. 1 20 pts.,	29.66	22.3	7.16	10.12
6	No. 5 100 pts.—No. 1 20 pts.,	26.77	19.2	7.57	10.20
7	Milk from 1 Holstein cow,	12.15	3.3	8.85	10.01
8	No. 7 partly creamed,	15.90	7.50	8.40	10.00

It will be seen from the results given in this table that while the actual per cent. of solids not fat in samples 1, 2, and 3, representing the milk, cream, and skim milk, are very different the ratio of solids not fat to water in the three samples is constant.

Furthermore, the ratio of solids not fat to water is also constant in samples 4, 5, 6, and 8, which are mixtures of cream and milk in different proportions.

In view of these facts, a consideration of the ratio of solids not fat to water furnishes valuable assistance in the detection of a watered milk containing cream.

Occasionally very abnormal samples of milk have been received from agents of the State, and among them were some which contained added water and an excess of fat, the latter being due either to the fact that the milk had partially creamed before the sample was taken, or contained cream intentionally added.

The influence of added water on the ratio of solids not fat to water in milks containing varying quantities of butter fat or cream is shown in the following table:

TABLE VII.

Number.	Sample	Total solids.	Fat.	Solids not fat.	Solids not fat to 100 pts. water.
1	Milk,	12.20	3.6	8.60	9.79
2	Cream,	33.14	26.6	6.54	9.77
3	80% No. 1,	16.32	8.2	8.12	9.70
	20% No. 2,				
4	90% No. 1,	11.08	3.3	7.78	8.74
	10% water,				
5	80% No. 4,	15.41	8.0	7.41	8.70
	20% No. 2,				
6	Milk,	12.62	4.0	8.62	9.86
7	90% No. 6,	11.36	3.6	7.76	8.75
	10% water,				

Sample No. 1 is milk somewhat below average in quality, the product of one herd of cows. No. 2 is cream from the same milk, and No. 3 is a mixture of 80% of the milk and 20% of the cream. In these three samples, the ratio of solids not fat to water is constant, although the actual percent. of solids not fat differs considerably. But in sample No. 4, which contains 10% of added water, the solids not fat to 100 parts of water is strikingly decreased, and is lower than in any of the samples of exceptionally poor milk, obtained from grade Holstein cows, that furnished the results given in the preceding tables under Dairy No. 1 and No. 2. In sample No. 5, which contains 8% added water, the low solids not fat might possibly be attributed to the fact that the sample contains an excess of fat; for an inspection of the preceding tables will show that in the creaming of milk there is a decided lowering in the per cent. of solids not fat. If, however, we turn our attention to the solids not fat associated with 100 parts of water, we find that there is a very marked decrease in this figure, and the preceding tables have shown that this decrease should not take place if both the cream and the milk are pure. In this case, the decrease is so great that the figure falls much below the limit for pure herd milk, even of the lowest type.

The ratio of solids not fat to water will not take the place of other methods used for detecting added water, but it is a valuable addition and may be used to save the chemist unnecessary labor.

For example, in No. 5 the solids not fat are 7.41% and the total solids are 15.41%. From these figures, the ratio of solids not fat to water is found to be 8.70 to 100. This indicates that a further examination should be made, including estimation of ash, etc.; but, if the solids not fat in the sample had been as high as 8.10%, the ratio would have been 9.57 to 100, and would indicate that the milk was probably pure, and that a further examination would furnish no proof of adulteration.

In case of very rich milk such as that furnished by Jersey and Guernsey breeds, a determination of fat, total solids, and specific gravity does not give sufficient information for the detection of a small amount of added water. This fact is made clear by the figures given in the following table:

TABLE VIII.

Number.	Sample	Specific gravity.	Total solids.	Fat.	Solids not fat.	Solids not fat to 100 pts. water.
1	Cream,	.....	44.36	38.7	5.66	10.17
2	Milk,	1.032	14.73	5.5	9.23	10.82
3	1 Jersey cow,	1.023	19.36	12.2	8.25	10.23
3	4 vols. No. 2,					
	1 vol. No. 1,	1.029	13.27	4.9	8.37	9.65
4	9 vols No. 2,					
	1 vol. water,	1.0235	19.14	11.40	7.74	9.57
5	4 vols. No. 4,					
	1 vol No. 1,	1.0315	16.55	6.90	9.65	10.97
6	Milk,					
	1 Jersey cow,	1.029	14.91	6.2	8.71	10.23
7	9 vols No. 6,					
	1 vol. water,	1.0335	14.51	5.0	9.51	11.12
8	Milk,					
	1 Jersey cow,	1.0305	13.27	4.5	8.77	9.98
9	9 vols. No. 8,					
	1 vol. water,	1.0323	12.46	3.9	8.56	10.29
10	Milk,					
	1 cow,	1.0295	11.70	3.5	8.20	9.28
11	9 vols No. 10,					
	1 vol. water,					

Sample No. 4 in this table is the milk of one Jersey cow (No. 2) to which ten per cent. of water has been added. The effect of the added water is clearly shown by a comparison of the figures in row 2 with those in row 4. If, however, the sample of milk No. 4 had been received by a chemist who had no knowledge of its origin, he would probably regard it as abnormal because a milk containing 4.9 per cent. of fat is not usually associated with such a low specific gravity as 1.029, nor so low a per cent. of solids not fat as 8.37. But this abnormality may be due to either of two causes. It may be a rich milk

containing added water (which in this particular case is true), or it may be a pure milk partially creamed. A milk having a specific gravity of 1.030, total solids, 11.90%, fat 3.5%, solids not fat, 8.40, would, when creamed, so as to have 4.9% of fat, give the remaining figures as represented in No. 4; and a milk containing 3.5% of fat and 8.40% of solids not fat would not be exceptional, particularly if it represented the product of one or a few cows. The truth of this statement is shown by the results of analyses of samples 9, 10, and 14, Table V, Dairy No. 2.

Sample No. 7, also containing 10% of added water, might be produced by the partial creaming of a poorer milk.

Sample No. 9, with its 10 per cent. of added water, shows from the figures here given no evidence of adulteration, and would probably pass inspection.

Sample No. 11, which is produced by the watering of a milk of medium quality, would require a much more extended examination before the presence of water could be safely declared.

In spite of the wide variation in composition of milk and the consequent possibility of an occasional sample of watered milk escaping detection, I believe that the adulterations that actually occur are in the great majority of cases sufficient to make themselves evident to the chemist. The following very evident case of adulteration of milk with added water is an extreme illustration of a type of samples, to which reference has been made, that are not only watered but also creamed. In many cases the evidence is not as strong as in this one. The results of analysis are:

Specific Gravity.	Total solids.	Fat.	Solids not fat.	Ash.	Solids not fat to 100 parts water.
1.025, ...	11.28%	4.36%	6.92%	0.57%	7.79

The percentage of fat in this sample taken alone indicates a pure milk of good quality. All the other figures prove clearly and positively the presence of about 20% of added water. A milk sufficiently rich in fat to show 4.36% of fat after the addition of 20% water would be associated with sufficient solids not fat and total solids to require the addition of at least 25% of water to reduce them to the figures given in this sample; and if 25% of water were added, the fat in

the original sample would have to be 5.8%. In other words, in order to produce the figures obtained by analysis of this sample, by simply watering normal milk, the milk before watering would have to contain at least 15% of total solids and 5.8% of fat. Herd milks of this character can be found but they are extremely rare. In fact, so rare that one may assert with reasonable certainty that the sample in question is the result of both watering and creaming.

In this paper it has been my purpose to present the possibilities of detecting the presence of added water in milk by a determination of the total solids and fat. From this data one can calculate the solids not fat associated with 100 parts water.

If none of these four figures furnish grounds for suspicion it is not likely that a more complete examination of the sample will furnish evidence of adulteration either by watering or skimming.

In the detection of skimming, the relation of the fat to the solids not fat is a matter of primary importance. For example, a sample of herd milk contains 3.25% of fat. If the solids not fat are between 8.3 and 8.7% it may be a pure milk of low grade. See Table IV, Dairy No. 1. If the solids not fat fall to 8%, the milk is probably watered, and should receive further investigation. If the solids not fat rise to 9%, the milk has been partially skimmed.

We have seen that the ratio of fat to solids not fat is very different in poor milk and in rich milks. In other words, the ratio varies with the percentage of fat. In a normal milk, containing 3.25% of fat, the solids not fat will be from 2.5 to 2.6 times the fat; while in a milk containing 4% of fat, the solids not fat will be from 2.2 to 2.3 times the fat. If the fat falls to 2.7%, the normal solids not fat would be about 3 times 2.7, but if it rises to 5% the solids not fat would be about 1.9 times the fat.

BUTTER.

By Prof. C. B. Cochran, West Chester, Pa.

In undertaking to write about butter my thoughts are so strongly directed to the butter making of the past that I cannot refrain from briefly relating the process as I have seen it. Perhaps the history of the manufacture of no other familiar article of food will better illustrate the wonderful changes that have taken place in domestic and industrial life during the last fifty years.

In my boyhood days butter making did not constitute a business in itself because it formed one of the many smaller or subordinate industries to be found on every farm at that time. In every village or small town not exceeding a population of 2,500 to 3,000 souls, the possession of a cow by each well-to-do family was quite common. In such towns there was no place for a milk dealer. Each family who did not have its own milk supply, sent to a neighbor. Going after the milk was one of the daily duties of many a boy of the past generation.

While butter was a product of every farm, on none was it anything more than one of the several side issues. Every farmer kept a few cows, but no farmer kept a large herd. Butter was made, sufficient for the family use and, for at least a part of the year, the housewife would have a few pounds each week to exchange at the neighboring store for coffee, sugar, or such other groceries or dry goods as were needed for the home or for some of its members.

In those days all the expenses for the maintenance of the home, including furniture and clothing for the family, were quite generally supplied by the subordinate industries or side issues of the farm, the sale or exchange of small fruits, chickens, eggs, an occasional pig or a sheep furnished running expenses, leaving the money obtained from the sale of the farm crops such as apples, potatoes, wheat, hay, &c., to be used for paying a mortgage, for improvements, or for investment.

Those were primitive days of simple life with many thoroughly enjoyed pleasures, but also with much hard manual labor for young and old of both sexes; days when the farmer's family enjoyed social and political supremacy and when the aristocracy of the land were in the country raising wheat and potatoes on farms of less than 200 acres and trading at the village store the minor farm products for household provisions.

The following method of butter making was at that time very generally used in my native state:—Shallow pans about 13 inches in diameter were filled with milk to the depth of about two inches and allowed to stand until the creaming process was completed. As it was desirable to keep the milk at a low and uniform temperature, and as the cellar was the only available place approximately furnishing such a temperature, this operation was conducted in the cellar.

When the rising of the cream was completed, it was skimmed off and transferred to a stone jar where it was allowed to ripen until a sufficient supply had been collected to form a churning. In each household this time was subject to some variation, depending upon

the varying consumption of milk by the family. During the time of harvesting of hay, wheat, and oats, when many hands were employed and fed at the family table, the intervals between churning would be somewhat increased.

The operation of churning was conducted in a tall cylindrical or slightly conical jar made of wood or stone and provided with a lid through a hole in the center of which passed the handle of the churn dasher. The operator, usually one of the younger members of the family whose time could be spared for this necessary, but tedious, work, protected by a long apron from the spattering cream, kept this handle moving up and down until the butter had formed. As the time for the production of the butter varied greatly, the young operator frequently possessed aching arms long before the process was completed and his or her attention was fixed upon the ring of cream around the hole in the lid through which passed the handle of the dasher, watching eagerly for the first appearance of butter granules which announced approaching release from the task. In after years when I found students in my classes who knew little or nothing of the process of butter making, I felt that they had missed one of the interesting experiences of life. The operation of collecting the butter from the buttermilk, working and salting was carried out by an older and more experienced person in much the same manner as at the present time.

Butter made in this manner varied greatly from time to time in color, consistency, and flavor, and large quantities of butter that would now be considered unfit for a retail market were consumed. Some of the causes for poor butter made under these conditions will be briefly mentioned later in this article.

The diagram here given shows the separations produced in milk in the ordinary process of butter making, whether the cream is obtained by the gravity process or by a centrifugal separator.

Milk { Cream, { Butter. / Buttermilk.
Milk { Skimmed Milk, { Cottage Cheese. / Whey.

By the process of churning and subsequent working, the separation of the cream into butter and buttermilk is never complete, consequently there will be found in the buttermilk a small amount of butter, and in the butter, varying quantities of buttermilk, together with the added salt. Since buttermilk is a complex liquid containing water, milk sugar, lactic acid, proteids (casein) and mineral matter, all these constituents will be found in the butter.

Stated in terms of fat, buttermilk, and salt, the average composition of buter is—fat 86%, buttermilk 12.5%, salt 1.5%.

The composition of butter is practically never expressed in the manner here given, for the reason that buttermilk is itself a complex aqueous liquid of the following average composition:—Water 91.00%, Fat 0.5%, Milk Sugar 4.5%, Proteids 3.3%, Ash 0.75%.

The following table represents the average composition of butter manufactured in different localities:

Made in	Iowa, U. S. A.	England.	France.	Germany.	Denmark.	Sweden.	Australia.
Number of samples, ...	221	72	5		17	25	
Butter fat, ...	84.00%	86.85%	84.34%	85.24%	83.41%	82.89%	84.50%
Water, ...	12.73%	11.54%	12.05	12.24	13.42	13.75	12.70%
Curd, ...	1.30%	0.59	1.60	1.17	1.30	1.33	1.21
Ash (including salt), ...	1.97	1.02	2.01	1.35	1.87	2.03	1.57

The 221 samples made in Iowa were taken from 55 different creameries located in different parts of the State. The water content of butter made in the same creamery will vary to some extent from day to day. Two successive batches even though made on the same day may show a difference in the amount of water they contain. The average amount of water is said to be slightly higher in butter made in winter than in summer. There is more water in fresh butter than in salt butter and more in butter when first made than when 10 to 30 days old.

Because of the readiness with which a large excess of water may be churned into butter without making it appear abnormally moist many countries place a legal limit upon the amount of water permissible in butter. In the United States, Great Britain, Ireland and Canada, the limit is placed at 16%. In Germany 16% for salted butter and 18% for unsalted butter.

During the year 1902, eight hundred samples of butter were taken for analysis by the Bureau of Animal Industry from 400 different creameries in eighteen different States of the United States. The following table gives the month in which the butter was made, and the highest, lowest and average percentages of water:

Percentage of Water.

Month.	Number of samples.	Highest.	Lowest.	Average.
May, ...	160	16.40%	7.20%	11.81%
June, ...	119	17.62%	8.19%	11.91%
August, ...	377	16.89%	7.23%	11.79%
September, ...	146	15.28%	8.30%	11.59%
Totals, ...	802	17.62%	7.20%	11.78%

Of 180 samples of Canadian butter, analyzed in the laboratory of Bureau of Chemistry of that country, 144 contained not over 10% of water, one over 16, and eight 14 to 16 per cent.

That the limit of 16% for the amount of water allowable in butter is a reasonable one, seems to be indicated by the fact that several large countries have independently fixed upon this limit, and also by the results of analyses given in the preceding tables.

The fat of butter differs distinctly in its chemical composition from all other fats used as human food. Fat and oils are chemical compounds of a base called glycerol combined with one or another of a group of substances known as fatty acids. The base of a fat or oil combined with the elements of water furnishes the substance known as glycerine. All fats and oils are alike in containing this base. Their chemical and physical differences are due to the different fatty acids with which this base is combined. Butter fat differs from other fats in the fact that it contains from 6 to 8% of fatty acids that can be distilled at the temperature of boiling water, and it is to the presence in butter of these peculiar fats which yield volatile fatty acids that its distinguishing characteristics and its desirability over other fats as an article of food are due.

A determination of the volatile fatty acids forms one of the most dependable methods of distinguishing butter from oleomargarine, and as a measure of the volatile fatty acids chemists make a determination called the Reichert-Wollny Number. This number, instead of indicating the actual per cent. of volatile fatty acids in the sample, gives the number of cubic centimeters of standard alkali required to neutralize the volatile fatty acids obtained from 5 grams of the fat when the work is performed under certain given conditions. The Reichert-Wollny Number is usually between 24 and 32. The United States Government has adopted 24 as the limit for this number. This limit has been wisely adopted in spite of the fact that it is known that butter made from cow's milk may at times show a much lower R.-W. number.

Examination of butter made in various parts of Holland under different conditions, conducted by the Holland Government, showed a variation from 17 to 32.1, and figures below 20 have been reported from other sources.

Some of the conditions which give rise to these abnormal butters with exceptionally low percentages of volatile fatty acids are now well known. One of the factors producing a very marked influence upon the percentage of volatile fatty acids in butter is the stage of lactation. Butter made from the milk of fresh cows has a high

Reichert-Wollny Number, while butter made from the milk of strippers has an abnormally low R.-W. Number. A sample of butter from the milk of a herd of strippers gave a Reichert-Wollny Number of 17.9, while butter made from the milk of the same cows when fresh gave the exceptionally high number of 36.3.

Another cause for a low percentage of volatile fatty acids in butter was made clear by the investigation of the composition of butter made in Holland conducted by Dr. Van Ryn.

It was found that the milk of cows kept on pasture late in the fall without stabling over night was low in volatile fatty acids. From the abundant data furnished in the report of Dr. Van Ryn the following illustrations are taken. Butter made on Sept. 7th from the milk of a herd of 30 Friesian cows gave a Reichert-Wollny Number of 28.8. Butter made on Nov. 2nd, a few days before the cows were stabled, gave the low number of 20.7. On Dec. 21st, in spite of the fact that many of the cows were approaching the end of the period of lactation, the Reichert-Wollny Number rose to 26.5.

The cause of the low percentage of volatile fatty acids in the butter from cows kept on pasture late in the fall without stabling was attributed to insufficient food and to exposure to inclement weather, but the extent of the influence of each of these factors was not investigated. Numerous examples illustrating the effect of prolonged lactation and late pasturage could be given.

One hundred and sixty-six samples of butter made in 166 factories in October and November from the milk of cows that were stabled every night gave Reichert-Wollny Numbers varying from 28 to 33, and in all but 5 samples this number was 29 or over.

There are many factors upon which the quality of butter depends, and among these factors the one whose importance is perhaps the least of all appreciated is the percentage of volatile fatty acids.

Some 22 years ago a manager of several creameries was placed in the following position:—A large proportion of the patrons of the smaller creameries were delivering milk from herds of strippers. These patrons demanded that payment should be made upon the basis of the percentage of fat in the milk. This the manager refused to do because the butter which he was then making at this particular creamery was no longer up to its usual standard. His customers were complaining and the sale of the butter was decreasing. Nine of these patrons whose herds were strippers left the creamery. When relieved of these strippers and supplied with one or two other dairies composed largely of fresh cows, it was found that the quality of the output was at once greatly improved.

Since this occurred, my attention has been called to several similar cases. From these cases I am led to the conclusion that one of the important factors upon which the taste of butter depends is the presence, in considerable quantity, of those peculiar fats which yield volatile fatty acids, and this conclusion is greatly strengthened by the fact that it is the presence of these same fats that distinguishes butter from other animal and vegetable fats and oils belonging to the dietary of man.

The great majority of creameries are amply protected from an excessive supply of milk from strippers because they depend upon dairies that keep up their milk supply throughout the entire year, and for this reason it is extremely rare to find upon the market of our State, butter having a very low Reichert-Wollny Number, but there are sections in which entire herds of cows are fresh in the spring and go dry in the winter, and there is therefore a possiblity of such butters being found upon our markets. If such a butter were subjected to chemical analysis the abnormal Reichert-Wollny Number would at once excite the suspicion of adulteration.

At least three other causes can be given which exert a marked influence upon the quality of the butter. There are, first, the food of the cows, second the length of time and the temperature at which the cream is allowed to ripen, and third, the character of the fermentation which takes place in the ripening cream. The food of the cows exerts a marked influence upon all three of the most important characteristics of the butter, color, consistency and flavor, but under normal conditions when cows are properly fed the flavor of the butter will depend upon the degree of ripening of the cream, the amount of acidity allowed to develop, and upon the character of the changes allowed to take place in the cream during this process.

This entire subject of the proper treatment of the milk for butter making belongs to the comparatively new science of bacteriology, and forms a very important part of the curriculum in every institution of learning where dairying is taught. Today, in nearly every creamery in the country, the ripening of the cream is carefully and intelligently controlled, for it is a matter of common knowledge that the flavor of the butter depends upon the control of this process.

In the process of butter making as I knew it more than forty years ago very little attention was given to the ripening of the cream, and consequently a large proportion of the butter produced was of very inferior quality. The science of bacteriology had no existence at that time, and little was known of the chemistry of dairy products. The knowledge of the experienced butter makers was limited to isolated facts of their own observation, or received from the preceding generation. The facts they did possess were in many cases

attributed to wrong causes. Fortunately, many a housewife of the past generation appreciated the value of cleanliness, and the importance of keeping the milk cool. Their lack of theoretical knowledge was in part offset by an extended practical experience begun early in life, and as a consequence butter of excellent quality was not unknown. At the present time, however, in those sections of the country where butter making is still carried on in the manner I have described, the product usually finds its way to one of the so-called creameries, or renovating factories, before it is offered for sale.

FEEDING AND MANAGEMENT OF DAIRY COWS.

By Prof. H. E. Van Norman, State College, Pa., Before Annual Normal Institute, State Board of Agriculture, Towanda, Pa.

Mr. Chairman, Ladies and Gentlemen: There has recently come into use a new phrase, and the thought and the wish has come into my mind, that this phrase might be applied in a different way. The phrase is, "Farming with Dynamite." I consider it one of the most sensible things that can be applied to the farm to-day, and I wish that the firm that has dynamite to sell would find some way to apply it to the farmer, as well. I believe that the best thing that could be done would be to give our farmers a charge of dynamite strong enough to lift them out of the rut in which they are.

This session is composed of representative Institute Lecturers of Pennsylvania, and Chairman of the County Institutes. This is not supposed to be an average audience, and I fear that sometimes we forget that fact. We are the exception, or else we have no business being here. You are the men who are the leaders in your counties, and you are the men who are going out to help the leaders in your respective counties raise the average man there up a little bit. Now, the last speaker is not an average apple grower on an average farm. He is an exceptional farmer and the exceptional apple grower, and I wish that somehow we could plant in the minds of our speakers the necessity to emphasize the thought that in order to get out of his rut, a man must do something more than the average man. Why is it that the last speaker could go out and compete with the Western apple grower? Because he did not sit down in a rut. The Western men got out the rut, and they can send their apples right in here, where we can produce them cheaper than they can, and we have to compete with them, and can't do it with the average man.

Now, to get down to my subject. I have no patience with the man who tries to run a successful dairy with the average cow. To be successful, he must get rid of that average cow, and get out of his rut. We got some figures from the patrons of our creamery at State College, of which there are one one hundred and eighty at the present time, and we found these conditions, viz: That on one farm there were fifteen cows kept; four of them did not pay for themselves, and the other eleven made a margin of two hundred dollars. Now, then, these four cows brought down the average. If they could be disposed of the other eleven would show a larger profit.

There is one thought that I want to impress very strongly, if I can, in regard to the management of a dairy farm, and that is, that in order to increase our profits, we need not look to our sale price, but we can do it ourselves on the farm.

Now, the man who is keeping eleven to fifteen cows and shipping his milk into New York might just as well look into this, because he cannot change his price. That price is regulated by the great law of supply and demand, and I don't believe the price is going to change very quickly; whether it is within the next sixty days, or within the next two years, the man who produces milk will have to take the price that is fixed by the great law of supply and demand. So we will eliminate that and take up the next proposition.

The first thing we must do is to eliminate that unprofitable cow and get rid of her very quickly. Why is it that every farm in this county is feeding two or three cows, not one of which pays for her keep? Simply because they are in a rut, and all the College can do, and the Farmers' Institutes can do, and all the State Board can do, and all the railroad can do, all the other agencies can do, is to apply a little bit of dynamite and jolt them out of their rut. Not even the Legislature can legislate profits into the pockets of the average man. All we can do is to show him how to get it.

Now, after we have eliminated the cow that is unprofitable, what shall we do with the others? I will confine myself to the feeding problem. I will also eliminate the fact of the high price of feed; that is something we cannot control. What can we do? The first thing we can do is to quit feeding that high priced stuff to the cow that does not pay for it. The next is, that the cow must eat three hundred and sixty-five days in the year and we must feed her something that is worth money. If the feed does not do it, we should add the profit in some other way. We sometimes forget the value of our pasture. We have it, and it must be made to produce some profit. Your cow should be made to produce a profit for every acre that she eats what grows on it.

The next thing is that she must not only be made to pay for her maintenance and her management, but she must pay for what it costs to produce her milk. Therefore the amount of milk produced in one year is a very important feature in the feed of that cow. I am not a very good chalk artist, but I believe some things sink in better through the eye, than through the ears. We have a dollar's worth of milk, and feed her ninety-nine cents' worth of feed: where is the profit? If we were to feed that cow a dollar's worth of feed, and get two dollars' worth of milk, there is some hope of getting a little real profit in it. The first thing to do is to know what we are doing. When we come to the feeding point, there are two things that enter in: the first is the ability of the cow to consume feed, and then to supply her with what she needs, not only in quantity, but in kind. Our Experiment Stations have been telling us for the last thirty years about "balanced rations," but it is only for the last five years that it seems to have come down to a practical working basis, and out of it has come the proportions I am giving you this morning. The man who keeps cows may fail to balance his rations, and still show a profit, but it is possible to make a mixture of feeds and feed it to the cow in proportion to her grain feed so as to give her the variety she wants, and be reasonably sure she has enough to give her ability to make milk and take care of herself. The first thing we want to remember is that she must have enough milk; the next thing is that in making up her mixture, we do not simply make a grain mixture.

Now we want to reduce it to figures, and we can do this according to the law of digestible nutrition, and it can be done according to our new standard. The cow must get enough protein, and, second, she must get enough energy to meet her requirements for maintenance and milk production. To many of you the term "energy," I think is new. The best definition of energy is a very short one: "Energy is power to do work." You can measure oats in a quart measure; you can measure oats on the scales; you can measure oats in terms of digestible nutrition. You can also measure these oats in terms of energy—the work they will do. You can put these oats into the furnace and burn them, and they will turn that energy into heat; we can put them into the engine, and they will produce steam; you can put them into the silo, and turn their energy into power, but power comes from the oats. Every feed we have can be measured thus, in the terms of its power to do work. Now you have the explanation. Lay it aside for a moment and, remember that there are only two things we are going to do—try to furnish that cow enough power to take care of

herself and to make her milk, and be sure that we remember that the energy comes from protein. You can get enough energy from sawdust, but you cannot get the cow to use it. She must have protein.

A thousand-pound cow requires five-tenths of a pound of protein and six therms of net energy every day, three hundred and sixty-five days in the year. The therm is the unit of measurement, just like a quart of oats, or a gallon of milk. If you want to know more about it, write for the Bulletin on "Computing Dairy Rations." If this cow is going to make twenty pounds of milk that will test 4% fat, it will require one more pound of protein and six therms of energy more or she will require a total of one and a half pounds of protein and twelve therms of energy per day. Now, if that cow has the ability to make twenty pounds of milk, and you only give her a pound of protein and eight therms of energy, there are just two things that can happen: If she is fat, she will rob her body and put it into the pail; if she is a dairy cow, or if she is not fat, she will not put it in the pail. And whenever you find that the cows are not putting it in the pail, if they are dairy cows, they are not given enough to do it with, because Nature has so fixed them that they will take care of themselves first.

Now, if she is to make forty pounds of milk, she will require another six therms, and another pound of protein. In other words, the more milk the cow makes, the cheaper she makes it, because she only has to take care of herself once. Some of our farmers do not think of that. They only think of the amount of food they use, and of the profit. We should think of the returns we are getting.

I wonder whether I have made this plain—that every cow should be fed to the limit of her ability to use it above maintenance. It does not cost more to maintain a twenty-thousand pound cow than any other because the cost of maintenance is practically the same.

How shall we feed our cow, so as to be sure to give her what she needs? Let us use a few figures: A 1000-lb. cow requires 5 lbs. protein and 6 therms for maintenance; if she is to produce 20 lbs. of milk, we must add one pound protein and six more therms of energy, making a total of 1.5 lbs. protein and 12 therms of energy for the production of twenty pounds of milk, and for maintenance. I would suggest this rule: feed one pound of grain to every three pounds of milk. Now, that is not the only rule, but it is a safe rule. You can give it to your ignorant farm hand, and if he follows it, you may be sure that there is no danger to your herd; or you can give it to your brilliant son, or to the college man, and your cows will be safe. According to that rule, the cow that produces twenty pounds of milk a day will require about seven pounds of grain, because three

into twenty is near enough seven to be called seven. Seven pounds of grain furnish about four therms of energy. Having given her the seven pounds of grain, give her all the roughage—good hay or silo or corn stover—that she will eat up clean, and she will get the other eight therms. By "grain" I mean any of the mixed feeds—corn meal, cotton seed meal—any of the mixed grain feeds. Grass I should count as roughage. Having, then, given her all the roughage she will eat, she has all the energy she needs, The roughage that furnishes this energy also furnishes a little protein, viz: About a half pound. Now, then, we can make our grain mixture so that it will furnish the other pound. We can make up a grain mixture that every time it furnishes four therms of energy, will furnish a pound of protein; that will be a 1-4 mixture. Give the cow three quotas of it, and all the roughage she will eat, and she is all right.

But the question comes up that I am feeding timothy hay and the other fellow is feeding alfalfa. Then our mixture will have to be made in accordance with the amount of protein necessary to make up the amount required to produce our quota of milk. For instance, we can use a 1-8 grain mixture. I don't want to confuse you by giving you a whole lot of figures. I simply want to give you the principles, and then you can send for the bulletin and think it over.

We have fed our cow seven pounds of grain, because she is giving twenty pounds of milk. That contains about four pounds of energy; the other eight will come from the roughage; that is the 1-4 mixture.

Has any one any questions up to this?

MR. L. ALDUS HERR: This twenty pounds of milk you are producing, what does it cost to feed? Suppose you use a mixture of silage, cotton seed meal, corn stover and corn once a day?

PROF. VAN NORMAN: I am not a lightning calculator; I will let some one else figure that out.

MR. J. ALDUS HERR: I can't answer that myself; but isn't it possible that a good dairy cow can consume more carbo-hydrates than one of the beef type? I have a beef cow that I must give corn once a day to keep her in flesh.

PROF. VAN NORMAN: Your are a sensible man; you are one of a body of men that are beyond the average; you know your cows. Now, so far as our experiments show, there is not nearly so much difference between cows as most people think. There is some difference, but not as much as people think. You look after your own feeding?

MR. J. ALDUS HERR: Yes, sir.

PROF. VAN NORMAN: And have you a man you could trust to do the feeding if you were away for six months?

MR. J. ALDUS HERR: No, sir.

PROF. VAN NORMAN: Well, that is the point. If you have this rule you can go away, and be sure that you will have at least nearly as good results as if you were there yourself.

MR. J. ALDUS HERR: Now, we use more carbo-hydrates. We grow corn in our county, and we find it cheaper to feed considerable of it because we know we get better results.

PROF. VAN NORMAN: There are a lot of factors that enter into the question, and which depend upon the individual. I cannot give you any hard and fast rule. Two men will take a pair of horses, and one of them will load up the wagon, and he cannot get started because one of the horses holds back. The other man gets on and takes the reins and starts off without any trouble. Now, that is not the horse; that is the man. So it is always the man behind the gun; but it is safe for the average man to have a rule, and if he cannot use it he is hopeless. This way we have no weighing out to do; we simply put it on the barn floor and mix it in the proper proportions, and there we have the 1-4 mixture.

The relation of protein and energy will depend upon the roughage we have. If our roughage is timothy hay and corn stover and silage, or any two of these, then we want to make up a grain mixture about 1-4½. If we have a good supply of clover hay with the timothy and silage, then about 1-5 is enough protein. If we have the clover hay, then about 1 to 7 or 8; so that our roughage shall determine the amount of grain our mixture shall carry. I have followed this rule, generally. Here is a mixture of 1-5. I simply give it because I have the figures here:

	Protein.	Therms energy.
400 lbs. cornmeal,	28	352
100 lbs cottonseed meal,	35	84
300 lbs. distillers' dried grains,	66	237
100 lbs. gluten feed,	20	71
	149	744

Now, if you will divide 149 into 744 you will find that the result is practically 5; in other words, here you have your 1-5 mixture. If you want a 1-4 mixture, you can use more cottonseed meal or corn and cob meal both of which are low in protein, and high in energy. Suppose you want a 2-4 mixture, take out half of the corn meal.

MR. McCALLUM: Professor, is there a possibility that there may be an excess of protein?

PROF. VAN NORMAN: Protein will perform the same functions to err on the side of a little too much rather than a little too little.

MR. KESTER: Can you deduct it from one and add it in with some of the others, as we shifted with the carbo-hydrates?

PROF. VAN NORMAN: Protein will perform the same functions as the carbo-hydrates, but we cannot make anything take the place of the protein. Mud will take the place of the brick, but the brick will not take the place of the mud. The difference between carbo-hydrates and energy is that carbo-hydrates is something, and energy is what that something will do, so we want a mixture of feed so balanced that they will produce sufficient energy to do it properly. Dr. Armsby in his calrymeter has shown that they mature more rapidly if we do this. We do not figure in decimals because you cannot prove to me that your timothy is exactly the same as I feed, or that your cottonseed meal is infallible in this respect; so we use only the whole numbers, which is close enough for all practical purposes.

MR. J. ALDUS HERR: The only objection I have to that ration is that three of those feeds I cannot grow; I must buy them.

PROF. VAN NORMAN: That is getting off a little bit, but I think it is one of the points that should be considered. If I can buy a hundred dollars' worth of feed and get a hundred and twenty-five dollars back, that twenty-five dollars is profit. Or if I can even get a hundred and five dollars for it, the five dollars is profit. Profit is the only element that enters into it. If you can grow something on a hundred acres that you can sell to better advantage and buy your feed, the only element then is what you can buy to feed at a profit. I think a whole lot of men make a mistake in thinking they can consume what they grow at a greater profit than they can buy feed for and feed it. There is no horizontal rule in this any more than the silage and roughage your cows will eat and then buy the grain feeds, I believe you will be doing business at a better profit.

MR. FENSTERMAKER: Why not grow alfalfa?

PROF. VAN NORMAN: That is very good; I am simply speaking in general terms.

MR. J. ALDUS HERR: If I don't use what I grow on the farm, there comes the expense of hauling it away, which means labor. And where am I to get a market for my corn and my fodder and my hay, that I grow on my farm, if I buy the high-priced feeds instead of feeding what I grow?

PROF. VAN NORMAN: Use it.

MR. J. ALDUS HERR: I can't; we grow too much.

PROF. VAN NORMAN: Then keep more cows.

MR. J. ALDUS HERR: Can't; we have reached our limit.

PROF. VAN NORMAN: Here we have one of the factors on which the individual has to work. If you have a small farm, or if you have a large farm, and grow more than you can use, then produce your own protein. There comes in your old-time principle that is so often preached—don't buy your high-priced feeds. I say buy them if necessary to feed at a profit.

A MEMBER: Early in your remarks you advised feeding the dairy cow to the limit of her capacity; what is the capacity of a dairy cow; and, second, is there any danger in cottonseed meal?

PROF. VAN NORMAN: I mean in regard to her health, and to the limit of her health. When she begins to store it on her body, she is beginning to exceed her ability, and she loses in production. Some cows seem to have no limit; you can never give them enough.

A MEMBER: Then you had better sell them for beef.

PROF. VAN NORMAN: That depends; if it is more profitable to sell her for beef, then sell her for beef.

But you must take care of her during her trying time. You never see a fresh cow that is not thin during the first two weeks. She is drawing on her energy, and should be fed accordingly.

Cottonseed meal at the price of the last few years, is one of the cheapest feeds you can buy. If you make a mixture of three or four different kinds of grain, you will never have to use much cottonseed meal. Don't feed any one cow over four or five pounds, no matter what she does. There are some men who will feed six or seven pounds.

Cottonseed meal contains some objectionable product which is deleterious in some cases, but you rarely find trouble with it, so that it is considered practically safe.

MR. YOUNG: Is it possible to make a mixture of three of these ingredients that will do almost as well?

PROF. VAN NORMAN: Yes; but care should be taken to have it, as well as every other ration, palatable. Distillers' grains are light and bulky; the gluten feeds also furnish bulk. You might use wheat bran or wheat middlings and make a balanced ration, but your cows will not like it as well. However, I am talking now to the men who are going out to teach the farmers, and I want to give them a mixture that is as nearly fool-proof as possible. The 1-4 mixture is both safe and palatable to your cow.

MR. YOUNG: These feeds we must buy, and we must buy them in carloads. Still the small farmer cannot use a carload and he must get assistance from his neighbors to buy that carload. Now, if he must buy the gluten feeds and the distillers' grains, he must buy two carloads, but if he can substitute something else for one of them, he needs buy only one carload.

PROF. VAN NORMAN: Where is your State Grange, and Cow Testing Association? Why don't these organizations get together and take up these things? I want to say right here that in any community, if five or six fellows get together and go to the feed dealer and say to him "we will take five carloads and unload them at the station if you will reduce your profits," he will have no trouble in getting a reasonable price. I have known feed dealers to take a dollar and a half a ton under these conditions, where ordinarily they want three or four dollars.

A MEMBER: Where a man is not a dairy farmer, but keeps only three cows, is it possible to raise our own feeds cheaper than we can buy them?

PROF. VAN NORMAN: I believe it is, but I don't believe in this half way business. I would only have one cow to furnish feed to or I would go into the business in the right way. These fellows with five or six cows don't take proper care of them.

A MEMBER: Corn and cob meal and buckwheat help out on the grains, and they help out on the hay.

PROF. VAN NORMAN: That is a practical matter which applies largely to the individual. What is corn worth a hundred?

A MEMBER: $1.75.

PROF. VAN NORMAN: Now, if we buy a hundred pounds of corn meal at $1.75—

MR. COWAN: Where can you buy that?

PROF. VAN NORMAN: I don't know.

MR. COWAN: Neither do I.

PROF. VAN NORMAN: That is something you will have to work out for yourselves. I am simply using this as a basis from which to to teach you fellows to figure. If you buy a hundred pounds of corn meal at $1.75, you have your seven pounds of protein at the rate of—one pound would be one-seventh of that, or 25 cts. At that rate your protein costs you say $25.00 per hundred in corn; this supplies us 88 therms of energy at a practical cost of 2 cents (1-88 of $1.75) a therm or $2.00 per hundred. Now let us take cottonseed meal. What is that worth?

A MEMBER: $1.65.

MR. COWAN: $1.90.

PROF VAN NORMAN: All right; $1.90, then. At $1.90 cottonseed meal will furnish, say 35 pounds of protein, at 5 cents plus, or $5.00 for protein. The energy in a hundred pounds of cottonseed meal is 84 therms, or a little over 2 cents a therm. The energy in cottonseed meal is just a trifle more expensive than the energy in corn—$2.00 plus.

A MEMBER: At $1.60 or $1.70 it would be about the same.

PROF. VAN NORMAN: Yes, sir. The thing to do is to figure the cost of your feeds in this way, and then determine for yourselves which is the cheapest for you to buy, and then selcet the ones that furnish energy the cheapest. Usually it is corn, or corn and cob meal. Take them; what are they worth?

A MEMBER: 75 cents.

PROF. VAN NORMAN: For $2.20 in oats we get eight pounds of protein—about 27 cents a pound or $27.00 a hundred. That is not quite right; yet we feed them just because we raise them on the farm. Now, we figured out this week in our class that the man who had a hundred bushels of oats which he could sell at 50 cents and haul them into town and allowed him $2.00 for going into town and $2.00 for going back again, could buy the same amount of energy in cottonseed meal and save fourteen dollars in cash and have eighty pounds more protein. Now I want to emphasize two things: first, what are you getting for what you sell, and next, what does it cost you for what you put back—the same amount, or more? As a rule,

at the price of oats in this State, we can better sell them and buy some other feeds. Now, there may be conditions where a man may be justified in holding them. He may have to hire labor, which is expensive. Now, what are buckwheat middlings worth?

A MEMBER: White buckwheat middlings from $23 to $25 per ton. But the cow does not care for it because it is sticky.

PROF. VAN NORMAN: Mix it with something else.

MR. COWAN: Wheat bran or corn?

PROF. VAN NORMAN: No wheat bran for me at $27.00 a ton.

A MEMBER: One member said he raised all his concentrates except bran. Why not raise that?

PROF. VAN NORMAN: Because there is a screw loose somewhere. Now, I want to review a little bit: The first thing is to feed for maintenance; but the cow is not profitable unless she produces enough for maintenance and milk, so the next thing is to feed for profit and this can be done by a mixture that is sufficiently cheap, and light and bulky, feeding, as a rule, one pound of grain for each three of milk; or, it may be, one pound of grain for each four of milk; or, even, under some conditions, one pound of grain for each two and a half pounds of milk. Now, this is the rule which can be safely followed and it applies to the cow which produces twenty pounds a day, or sixty pounds a day. But now comes the question. How much to give her when she is not in milk? Well, she can live on roughage, if necessary; it is not advisable, but she won't starve to death. Then the next point is to find out at what price the different feeds furnish protein, and use that as a basis for your ration, making a mixture of different feeds for variety. A feed that is too constipating must be avoided and something more laxative substituted. The relation of protein to the energy in that mixture will be determined by the roughage. For timothy hay and corn and bran you will have to use more protein than when you feed clover hay or alfalfa. I believe you can figure out very easily. If not, organize a "Cow Cost Club" and hire a bookkeeper to figure it out for you. Carnegie does that, you know, and he would not do it unless it was the best thing to do.

MR. FENSTERMAKER: How about oil meal? Is it too high?

PROF. VAN NORMAN: Well, at the price of oil meal this winter, I would not use it. It is a laxative but you can get your protein cheaper.

MR. BIDDLE: At the high price of the oil meal this past winter, would not sorghum be a good substitute?

PROF. VAN NORMAN: It is thought to be so, but I would not speak as positively as I would on some other subjects.

MR. GOODERHAM: Up in Cambria, some of the people who were feeding cottonseed meal lost their cows and attributed it to the cottonseed meal. Those who lost their cows had put little troughs up and let them eat as they wished. Others mixed it thoroughly with feeds and had no trouble. Might this manner of feeding have anything to do with it?

PROF. VAN NORMAN: I don't know. I would not feed over six pounds of cottonseed meal a day under any circumstances, but I have known men to feed as high as twenty.

MR. FENSTERMAKER: Does that include the hulls?

PROF. VAN NORMAN: Sometimes it does, somtimes not. I think a good standard here is about three to four pounds.

MR. GOODERHAM: Mix it with silo?

PROF. VAN NORMAN: It doesn't matter. At the price of hay this last year, the grain feeds have furnished protein cheaper than the hay, and under those conditions it is a good plan to feed as much grain as possible, and as little hay. If you will send for Bulletin No. 114, you will able to get a little more information on this subject.

ESSENTIALS OF BUTTER MAKING.

By Mrs. Jean Kane Foulke, Division Farm Advisers, Department of Agriculture, West Chester, Pa.

Before Annual Normal Institute, State Board of Agriculture, Lancaster, Pa.

I feel as if I were undertaking a great deal in attempting to tell an audience of farmers how to make butter, because I am not what is termed an "expert" myself; that is to say, I am not a trained butter maker, never having taken a course in butter making in any agricultural school, or indeed in any school save that of experience. However, as you all know, experience is credited with being a good teacher, if a hard one, and it is possible, therefore, that mine may have taught me some lessons that may be of use to some of you.

To make good butter is not such a simple matter as it appears, and it demands a care and attention that is seldom given to it. This fact accounts for the amount of bad butter that you see sold and used, and is one reason why oleomargarine and other patent butter is in such demand. They not only are cheaper or as cheap, but they run more evenly good, keep better and taste better.

The first essential for good butter is to have good rich milk and clean milk, milk that is free from any extraneous flavor such as may be absorbed from the atmosphere, feeds or plain dirt. To get this, care must be taken as to the kind of feed used, especially if the milk is for butter. Milk that tastes all right and is all right for other purposes, when used for butter will not do at all. One can often distinguish the different tastes of feeds in the butter, and any radical change in the feeding may at once be detected. A little too much silage will spoil butter, and in cases where several cows' milk or the produce of the whole dairy is used, a knowledge of what each cow is getting, the amount, etc., should be carefully watched and known, and the effect upon her milk noted. This should be done in every dairy, as a matter of fact, as it is only thus that the feeding can be profitably done. Many cows do not need, and others do not digest, the kind of food and the amount of it that their fellows in the same stable should have. It is this knowledge of the individual that is a most important feature in any sort of dairying, and it is essential in a butter herd as a cow's milk is affected by her condition and this quickly affects the butter.

Having made sure that there is no taste in the milk from the feed that will show in the butter, the next thing is to be sure that the milk is cleanly drawn—that the milker has clean, dry hands, that the cow's sides and udder have been brushed and freed from manure and dust, loose hairs, etc., and that the milk is taken as soon as possible from the stable to prevent the contamination from the unavoidable odors and dust of a cow barn or milking shed. Care should be taken that the cans and pans are not exposed to road dust and manure and that they are scalded and washed thoroughly clean.

The milk is now ready for the dairy, and it depends very much upon whether it is to be separated or hand-skimmed what is to be immediately done with it; but as I am speaking of profitable butter making I assume that it is to be separated. In my opinion, milk for butter making should never be thoroughly cold. It should be cool, but never thoroughly chilled. In the dairy of which I have charge the milk is separated at a temperature of about 75 to 80 degrees. It is necessary to hold it over night, as we separate but once a day, so that the evening's milk is set in coolers or cans in the spring. These coolers hold about 12 quarts, a convenient size to lift.

Our spring water keeps about 56 degrees. I have a coal stove in the spring or dairy proper and keep a low fire all winter, keeping the temperature about 60 degrees and we try not to have it vary more than a degree or two one way or the other, and are very careful about ventilation and to prevent coal gas, dust, etc. Men are not allowed to enter the dairy in their working shoes nor is smoking allowed there. Care must also be taken after white washing. This dairy is an old fashioned spring house and has been made over somewhat to suit modern methods and increased trade. Of course it would be better if it could be heated by pipes and thus do away with the stove, which in this case necessitates covering the cream each time it is raked and the ashes removed, and great care in seeing that there is no coal gas which would affect the cream at once.

The cream should be stirred down every day and thoroughly mixed. To do this I have a round disk of tin, with a row of inch holes, fastened on a steel rod about two and a half feet long, about like a poker. This disk or tin plate is just large enough to fit inside the coolers and be moved up and down, allowing the cream to come through the holes and thus becoming thoroughly mixed. Cream should not be allowed to fall far from the separator to the can, as the air in the froth on it seems to make it rancid very soon and stirring down into the can ruins the whole can of cream.

Ripe cream is sweet cream soured. Soured cream has a pleasant smell and is not rancid or strong. It tastes good and is pleasant to eat. I know of no better dessert than a saucer of soured cream and a slice of soft ginger bread, and can think of nothing worse than to have to eat a saucer of sour cream even if accompanied by "angels' food."

Sour cream is cream that is spoiling and on the way to putrefaction, but soured cream or what is called ripe cream is luscious and sweet. It has reached a point of fermentation where it is still fresh and unspoiled, and has not yet begun to decay. To bring cream to this state at the time desired is a delicate matter. In my own case I have the coolers lifted out of the spring and stood on the cement floor, and into each one I put a little more than one-half pint of souring from twenty-four to thirty-six hours before churning. This in an atmosphere with a temperature of 60 degrees will ripen the cream sufficiently for butter making, although if the dairy temperature is lower it may take longer.

The souring is made fresh each butter day—we churn twice a week, each Monday and Thursday—by taking six quarts of separator skim milk and adding two quarts of fresh buttermilk, which is well mixed and kept stirring each day, the top being taken off before being used for souring.

The public demands butter of a good rich color, but except in Summer, and not always then, do even Jerseys give cream that will make yellow butter. Therefore the butter maker must resort to some of the many kinds of butter coloring that are on the market and are sold under the pure food laws. I have used "anato," which is a South American gum or root which comes in a powder very finely ground, a purely vegetable compound and entirely harmless. I know of but one place where it may be had and that is at Hansell's, No. 8 S. 18th Street, Philadelphia. I used to buy it by the pound but now it must be bought in five pound packages. It should be kept in a dry place. Preserve jars make good tight receptacles for it, and by opening one jar at a time the balance may be kept safely. I use at this season of the year and through the winter one tablespoonful to seven coolers of cream, mixing it first in about one quart of luke-warm water, and then stir it in the cream with the mixer described before.

The cream is now ready for the churn and to get the churn ready for the cream is the next step. I want to say here that scalding water, and plenty of it is a necessity to successful dairy work, and if one can have steam also it facilitates the work of cleaning and sweetening the dairy utensils, churn, separator, etc., enormously. The churn should be thoroughly scalded and rinsed, then chilled with plenty of fresh, cold water, after which it is ready for the cream, and we may begin churning. In this cleaning work use no soda and no soap except possibly to wash the rubber rings of the separator.

It should require about half an hour for the butter to come and as soon as you have butter the size of shad roe or very small marbles it is time to stop churning. After that to continue churning merely injures the texture of the butter. You get no more out of the cream but merely gather it into large greasy lumps.

Draw off the butter milk through a wire seive to catch the butter that will flow out of it. Then rinse the butter with cool not cold water and take it from the churn.

While the churning is being done, one should have scalded all the paddles, print, etc., to be used, also the butter worker, and should have chilled them afterward and left them in cold water. We set ours in the spring to await our needs.

The butter is put on the worker and the salt is spread over it. We allow half an ounce to the pound, and it should be weighed, not guessed at, unless you have buckets to hold the butter and measures for the salt that have been tested, so that you know what you are doing.

A sponge with a bit of cheese cloth about it makes a very useful thing in working butter. One should stand sideways to the worker with a sponge in one hand the paddle in the other, and keep turning the butter up and over to the worker, and keep constantly patting it with the sponge, thus absorbing the water more quickly and lessening the danger of destroying the grain by over-working to get dry. The water and the salt should, however, be well worked out, not only the experience can tell one when this is sufficiently done; but there is a look that means a little to the experienced butter maker that the butter is worked.

In butter, as in everything else that we want to sell, appearance counts for much and care should be taken to have the prints sharp and well cut, so that the butter may take the impression clearly, after which it should be neatly wrapped in butter paper and set in pans to harden. In Summer the butter is often too soft, when first printed to wrap and should be laid on open papers in the pans and wrapped later. The triangular point of paper at each end of the package should be turned under, rather than upwards, in wrapping as it makes a neater package. Some persons have naturally cool hands and these are fortunate if they must handle and wrap butter. For myself, I have a warm hand and so must be continually dipping my hands and arms to the elbow in cold water to keep my fingers cool and dexterous.

Too much care cannot be given to the cleaning up after butter making, for much of the success of the next butter depends upon the sweetness of the utensils used; and especially when they are wood is it necessary to scald and scrub and steam them, clean, chemically clean, so that no animal fat may enter the grain to decay and thus destroy the possibility of making good butter or keeping the dairy tools sweet. It is impossible to get them thoroughly clean if once the grain gets full of rancid fat and grease.

The dairy should be light and cool and well ventilated; not a dark, damp little cave as many of them are. It is impossible to make good butter without clean, sweet milk and cream, and clean, sweet surroundings; and it is this cleanliness and sweetness that makes the charm of the churn and that are the essentials of butter making.

THE CHAIRMAN: The paper is open for discussion if any person wishes to ask questions.

DR. CONRAD: About what percentage of fat is that cream, heavy or light?

MRS. FOULKE: Very heavy.

DR. CONRAD: I suppose 40 or 50?

MRS. FOULKE: Yes, sir. I made a few notes here that I thought would be interesting. I kept very careful account in connection with the dairy and I thought possibly they might interest some of you gentlemen as well as the ladies. In the dairy that I run we have milked 28 cows. They are grade Jerseys, most of them. We have a 13 horse-power boiler and 5 horse-power engine. That engine runs the separator and churn and butter worker and the pump that pumps the water to the mansion house. We have a 60 lb. Embree butter worker, cylindrical churn with perforated paddles.

Now I have been feeding 28 head 35 lbs. of ensilage, 1 lb. cottonseed meal and 10 lbs. of grain, 5 lbs. of Sugarine Dairy Feed and Holstein Grains; then about 8 lbs. of hay in the middle of the day. In January, 1911, we produced 711½ lbs. of butter; in February, 621½ lbs; March, 862 lbs.; April, 895 lbs. Of course, that was taking the dairy, some dry, some fresh and some just milking along. I struck an average for the year, from April 1st, 1910, to April 1st, 1911. I could not give the amount exactly of hay and straw used, neither could I give the account exactly of the cost of raising the corn for ensilage, but I did count the time taken to cut the corn and filling the silo and I took the wages of the two highest priced men on the place who have to do with the dairy and all the cost of bought feeds; also I counted the by-products of the place which I regard as very valuable in connection with the dairy. I bought some and sold some; and added on that, and I find that in the year from April 1st to April 1st we had made a net profit with those things taken out, of $2,115.13.

A MEMBER: When do you feed?

MRS. FOULKE: I have had the feed put in when the cows are put in.

A MEMBER: Before milking?

MRS. FOULKE: The feed was put out for the cows, of course in the winter when the cows are in the dairy. Now they are turned out and the feed is put in the troughs for them and they come in at supper. They get the ensilage after they are milked, just afterwards. I put the grains in and they get the ensilage afterwards.

A MEMBER: How long do you leave the butter stand after you have it printed?

MRS. FOULKE: I put it right away as soon as I can do it. Yesterday we made enough butter to have to work three different workings and went right to work as soon as we could. I have pieces of muslin cloth and we keep the butter in that after it comes off the worker and then we work it just as fast as we can.

A MEMBER: Have you had any experience in working the butter in the churn?

MRS. FOULKE: No, we do not do that.

A MEMBER: I understand your barrel churns roll?

MRS. FOULKE: Yes, roll round.

A MEMBER: This is round?

MRS. FOULKE: Yes.

MR. BARNES: Did I understand you to say that you held the milk over from evening to morning?

MRS. FOULKE: Yes, we hold the milk over from evening to morning.

MR. BARNES: Do you find that more profitable than while the animal heat is in the whole of it?

MRS. FOULKE: I have been doing it because if you want to start up the machines, if you have a boiler it takes considerable fire.

MR. BARNES: In our case we use a gasoline engine?

MRS. FOULKE: I don't know whether you are lucky or not.

MR. BARNES: We separate twice a day.

MR. RODGERS: At what temperature do you separate the milk?

MRS. FOULKE: 75 degrees.

MR. KERRICK: How about your ensilage material?

MRS. FOULKE: I leave it go until the leaves begin to turn and it is about time to mature and then it comes in with the rest of the farm work. That is, I think the more corn it has in it the better it is. The best ensilage I had I made from millet. I had a little millet. We thought we would be short of hay and we planted millet; then the hay came on; and I cut it just as the seed was becoming round. We cut it the way you cut oats and we put it in the silo and we didn't empty the silo for three years and it was as good at the end of three years as when it went in.

A MEMBER: Would your butter stand up better than creamery butter?

MRS. FOULKE: Better. I sell it in West Chester to a very careful community. They are most of them Friends and they know when they spend money, and several people have said to me that one pound of my butter would go as far as one and one-quarter pounds of creamery butter or other butter.

A MEMBER: What price do you get?

MRS. FOULKE: I would not take less than fifty cents just at West Chester, and for some butter I get seventy-five cents.

MR. CLARK: There is an agitation all over the country—there is a law—I do not know whether it will pass this week—that you have got to sell full weight now.

MRS. FOULKE: I do that.

MR. CLARK: Suppose you put up a pound print, how long will it remain a pound brick?

MRS. FOULKE: My butter is so good that people eat it before it has time to shrink.

MR. CLARK: The Elgin people supply nearly all of the butter in the western part of the State and when it goes into the market to the consumer it weighs but a fraction over fourteen ounces, never very much more than a fraction over fourteen ounces. What is that fellow going to do?

MRS. FOULKE: I would try not to buy that butter.

MR. CLARK: They say they put up pounds. What is the reason for the loss?

MRS. FOULKE: I think they put it up all right but they put a lot of water up with it and water will evaporate. Butter well worked will stand up.

MR. CLARK: It will not lose that much?

MRS. FOULKE: It will not lose at all.

MR. CLARK: These fellows are in Harrisburg lobbying now?

MRS. FOULKE: Oh, well, I can't vote.

A MEMBER: What percentage of moisture is there in butter after it is worked?

MRS. FOULKE: Not any at all. I work mine as dry as I can get it.

A MEMBER: What is the average income on each cow? You say you had 28 cows?

MRS. FOULKE: I do not think I could tell you that. If I had known that you were going to ask me that question I could have answered.

A MEMBER: How many acres of land do you have?

MRS. FOULKE: The two farms that I have charge of make about 150 acres; and I also rent a great deal of extra land from neighbors or else buy the crop. Last year I had between thirty and forty extra acres costing about $76.00.

A MEMBER: Do you pasture your cattle?

MRS. FOULKE: Last year I did.

A MEMBER: Did you ever run over a year that you did not pasture?

MRS FOULKE: No, I never tried that.

MR. DEWITT: I wish to make a little statement. We have up in our country a condenser near Mansfield, Tioga County. A man coming from the vicinity of the condenser has ten cows; just cows not only fancy breed but good looking cows. I saw the cows. He patronizes that condenser. His cows brought him in $96 a year without any of this extra trouble, a piece.

MRS. FOULKE: $76.00 a year over and above the cost of food and labor would be the average for each of my cows.

A MEMBER: You did not figure out all the feed.

MRS. FOULKE: Total profit of $2,115 on 28 cows would be just about $76.00 a piece profit after the labor and feed were paid for. The only thing I did not account for was the hay and the corn in the ensilage; but against that I left the heifers, I left 15 heifers; and the manure certainly ought to cover the hay.